



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PREVENTION, PESTICIDES, AND TOXIC SUBSTANCES
WASHINGTON, D.C. 20460

June 1, 1999

MEMORANDUM

SUBJECT: PIRIMIPHOS METHYL: The ORE aspects of the HED Chapter of the Reregistration Eligibility Decision Document (RED), Case #819418, PC Code 108102, DP Barcode D256632.

From: Susan Hanley, Chemist
Reregistration Branch I
Health Effects Division 7509C
and

Jeff Dawson, Chemist
Reregistration Branch I
Health Effects Division 7509C

Thru: Whang Phang, Branch Senior Scientist
Reregistration Branch I
Health Effect Division 7509C

To: Christina Olinger, Chemist
Reregistration Branch I
Health Effect Division 7509C

A revised version of the Occupational and Residential aspects of the Human Health Assessment for the Reregistration Eligibility Decision (RED) document for pirimiphos methyl is attached. This chapter is based on the Hazard Assessment from Jess Rowland, Executive Secretary of the Hazard Identification Assessment Review Committee (HIARC), to Whang Phang, Branch Senior Scientist of Reregistration Branch 1 (April 21, 1999). The HIARC selected doses and toxicology endpoints for risk assessment solely based on animal toxicity studies. The HIARC decided that due to technical limitations the human studies submitted were supplemental and not sufficient for endpoint selection or risk assessment. The toxicology database for pirimiphos methyl was reviewed and new endpoints and margins of exposure (MOEs) for short-term and intermediate-term exposures chosen. The previous occupational and residential risk assessment for pirimiphos methyl was peer reviewed by Kathryn Boyle and brought before the HED Exposure SAC to discuss the risk assessment approach used for

the iris bulb treatment scenario (memo; J. Dawson, April 9, 1998, D24075). This document is consistent with the previous document in use of the policies and data and is written to reflect the changes in the new endpoints, uncertainty factors, and doses assigned by the HIARC.

Summary of Significant Items

- Label language referring to PPE and engineering control use has to be altered to reflect basis of this assessment. This assessment was based on use patterns described by the registrants in a January 1998 SMART meeting.
- Inhalation risks were assessed for the iris bulb fogging scenario using a comparison of a modeled exposure concentration versus the acute inhalation endpoint concentration (5.04 mg/L). The difference was over 5 orders of magnitude. If the modeled exposure concentration of 0.00036 mg/L value is used to calculate a dose level using standard exposure parameters (i.e., 29 Lpm, 60 kg, and 2 hours per day), the resulting dose is 0.021 mg/kg/day which results in a short-term MOE of 710. This may not be biologically relevant because of the route-to-route extrapolation required (i.e., the MOE is based on an acute oral endpoint and inhalation would be the primary exposure route in this scenario because of the application method and the use of mitigation such as Tyvek clothing and protective gloves).
- Intermediate-term assessments were completed for handlers even though in some scenarios intermediate-term exposure patterns may not occur. There are notable exceptions such as seed treatments that still prompted the inclusion of intermediate-term scenarios in the assessment.
- The proposed label uses were included in this document in order to conserve future HED resources.

4. Occupational and Residential Exposure/Risk Characterization

Exposure data requirements are triggered based on the potential for exposure and the toxicological significance of the active ingredient. All nondietary exposure/risk assessments completed for pirimiphos methyl are presented in this chapter. The only exposure scenarios that were identified for this risk assessment are occupational in nature. No residential exposure scenarios were considered by the Health Effects Division in this assessment because of anticipated pirimiphos methyl use patterns. Use patterns and available products are summarized in a manner appropriate for nondietary risk assessment in *Section 4a: Use Pattern/Available Product Summary For Exposure Assessment*. The exposure/risk assessments that have been completed for each exposure scenario, for which appropriate data exist, are included in *Section 4b: Occupational and Residential Exposure/Risk Assessment*. The characterization issues associated with, and a summary of the results of each assessment, are included in *Section 4c: Occupational and Residential Risk Characterization*.

a. Use Pattern/Available Product Summary For Exposure Assessment

Pirimiphos methyl containing products are described in this section. Additionally, available information that describes the manner in which pirimiphos methyl products are applied is provided in this section (e.g., use categories/sites, application methods, and application rates).

i. End-Use Products

Pirimiphos methyl [O-(2-(diethylamino)-6-methyl-4-pyrimidinyl) O,O-dimethyl phosphorothioate], is an organophosphate insecticide that is marketed in a variety of end-use products. Pirimiphos methyl formulations include liquid concentrates; ready-to-use solutions; and treated articles (i.e., cattle ear tags). The following table summarizes all active formulations based on a review (2/2/98) of the *Office of Pesticide Programs -- Label Use Information System (LUIS)* and information received, including labels, at the January 28, 1998 SMART meeting with representatives from Wilbur-Ellis and Schering-Plough.

Formulation Type	Percent Active Ingredient	EPA Reg. Numbers
Liquid Concentrates	57 (5 lb ai/gallon)	002935-00486 & -00487 WA90003800
Ready-to-Use	27 (~2.4 lb ai/gallon)	proposed
Treated Articles (Ear Tags)	14 & 20	00773-068 (20%) & 00773-081 (14%)

All products appear to be marketed solely for occupational use. There are no products intended for sale to homeowners or for occupational use in the residential marketplace. Existing products are intended for direct animal applications (773-068 & -081), stored grain and seed

treatments (2935-486 & -487), and greenhouse applications (WA90003800). New uses and modifications to existing labels were also proposed at the January 28, 1998 SMART meeting that include adding a ready-to-use liquid direct animal treatment product (27% RTU) and including bin surface treatments to be completed in lieu of admixture or top dress treatments of stored grain (2935-486).

ii. Mode of Action and Targets Controlled

Pirimiphos methyl is an organophosphate insecticide used for the control of many types of pests on stored grain and seeds. Additionally, pirimiphos methyl is used as a fly control compound on livestock. The types of pests that pirimiphos-methyl is used to control include (but are not limited) to the following based on a review of available labeling and the LUIS report:

- **On grains and seeds:** cigarette beetle; confused flour beetle; corn sap beetle; flat grain beetle; hairy fungus beetle; red flour beetle; sawtoothed beetle; granary weevil; maize weevil; merchant grain beetle; rice weevil; lesser grain borer; and angoumois grain moth, Indian meal moth and almond moth on corn (seed and whole-grain), rice (whole-grain), wheat (whole-grain), and grain sorghum (seed and whole-grain); and
- **On iris bulbs:** mealy bugs and mites.
- **On livestock including beef cattle, non-lactating cattle, and calves:** horn flies and face flies.

iii. Registered Use Categories and Sites

An analysis of the current labeling and available use information was completed using the LUIS report in addition to the U.S. EPA *Reference Files System (REFS)*. This information indicates that pirimiphos methyl can be used on the following sites:

- **Terrestrial Food & Feed Crops:** rice, sorghum, wheat, and corn;
- **Indoor Food:** non-lactating dairy cattle, beef/range/feeder cattle, and calves;
- **Indoor Non-food:** nonfeed/nonfood containers-empty; and
- **Terrestrial Non-food Crops:** iris bulbs.

iv. Application Parameters

Application parameters are generally defined by the physical nature of the use site, by the equipment required to deliver the chemical to the use site, and by the application rate required to achieve an efficacious dose. Pirimiphos methyl applications are primarily intended to control

pests in stored grain and seed; to control flies on livestock; and to control mealy bug infestations on stored iris bulbs.

Applications to stored grain intended for consumption can be made according to current labeling using admixture (i.e., treating grain as it is transferred to storage bins such as elevators) or top dress treatments (i.e., treating top layer of grain stored in a bin or elevator to create a barrier-analogous to intent of termiticide barrier treatments). The registrant also proposed, at the January 1998 SMART meeting, revising labels to allow an additional application method (bin disinfestation) in which the surfaces of empty storage bins would be treated in order to establish a protective barrier prior to adding grain. [Note: labeling specifically precludes combining treatments on specific lots of stored grain (i.e., grain for storage can only be treated once by any of the available techniques because of dietary residue concerns).] The following information, excerpted from the labels and other information presented by the registrants at the January 1998 SMART meeting as well as data supplied to the Health Effects Division from the Biological and Economic Analysis Division, can be used to described pirimiphos methyl applications to stored grain:

- **Admixture Treatment (EPA Reg. 2935-486):** “Apply spray solution uniformly with suitable application equipment as grain enters storage or export containers. Select nozzle size and operating pressure to adjust the application rate with the flow of the grain. Prepare desired dilution of Actellic 5E insecticide in spray tank and mix well. Make sure spray solution stays mixed, especially in large holding tanks. Apply the spray solution as a coarse, uniform low pressure spray in order to minimize drift. Shield nozzle if necessary. Apply the specified amount of Actellic 5E insecticide in 5 gallons of water or 3 to 5 gallons of at least twice refined soybean oil to each 30 tons (60,000 pounds) of grain according to the following rates” in order to achieve a target concentration of 6 to 8 ppm. The label specifies that 9.2 to 12.3 ounces of formulation should be used to treat 30 tons of grain in 5 gallons of water (i.e., 9.2 ounce rate = 0.036 lb ai/5 gallons, 0.36 lb ai/30 tons, or 0.012 lb ai/ton and 12.3 ounce rate = 0.48 lb ai/5 gallons, 0.48 lb ai/30 tons, or 0.016 lb ai/ton). The label language does not specify particular types of application equipment. An addendum to the label entitled “Application Guidelines” does however specify a closed system for admixture treatments. As a result, HED has based the admixture assessment solely on the use of closed systems (**labels should be revised to account for this indication by the registrant**).
- **Top-Dress Treatment (EPA Reg. 2935-486):** “To each 1,000 ft² of grain surface apply 3 fluid ounces of Actellic 5E Insecticide diluted in two gallons of water. The treatment should be split as follows. Spray half of the mixture evenly over the surface and rake into the grain to a depth of 4 inches. Apply the remaining half of the mixture (1 gallon) to the raked surface” in order to achieve a target concentration of 8 ppm. The label specifies that 3 fluid ounces of formulation should be used to treat the specified area (i.e., 0.12 lb ai/2 gallons or 0.12 lb ai/1000 ft²). The label language does not specify particular types of application equipment. As such, HED has based the risk assessment on equipment that can potentially be used for this type of application.

- **Proposed Bin Disinfestation Treatment:** “Actellic bin disinfestation treatments may be used immediately prior to storage of any grain to which direct application of Actellic is allowed. Dilute 2.6 fluid ounces of Actellic 5E per 1000 ft² of bin surface in an appropriate quantity of water (i.e., 0.10 lb ai/1 to 4 gallons or 0.10 lb ai/1,000 ft²). Because different construction materials have different absorptive capacity for liquids, the following volumes of water are suggested to dilute Actellic prior to application. Following these suggested dilutions will allow adequate diluted Actellic spray to thoroughly and evenly cover the structure surface without resulting in excessive runoff of the spray.” The label specified that spray volumes for various materials should be (gallons of water/1000ft²): wood - 4; concrete/plaster/brick - 2; and metal - 1. [Note: Information included with the proposed label the registrants calculated that approximately 15 percent of the pirimiphos methyl required for an admixture treatment would be required to treat the same 30 tons of grain using the bin disinfestation method.] The label language does not specify particular types of application equipment. As such, HED has based the risk assessment on equipment that can potentially be used for this type of application.

Seed treatment applications can be made according to current labeling using admixture (i.e., treating seeds during transfer to storage) or pour-on treatments (i.e., treating bagged or bulk seed using a self-totalizing open-pour bottle). However, according to the registrants at the January 1998 SMART meeting, only closed systems are used to make seed treatment applications **(as a result, open-pour or other open systems have been excluded from the assessment -- labels should be modified to strictly reflect that open systems are not allowable)**. The following information, excerpted from the labels and other information presented by the registrants at the January 1998 SMART meeting as well as data supplied to the Health Effects Division from the Biological and Economic Analysis Division, can be used to described pirimiphos methyl seed treatment applications:

- **Closed Admixture Seed Treatment (EPA Reg. 2935-486):** “Apply spray solution uniformly with suitable application equipment as seed enters storage or export containers. Select nozzle size and operating pressure to adjust the application rate with the flow of seed. Prepare desired dilution of Nu-Gro Insecticide SP in spray tank and mix well. Make sure spray solution stays mixed, especially in large holding tanks. Apply the spray solution as a coarse, uniform low pressure spray in order to minimize drift. Shield nozzle if necessary. Apply the specified amount of NuGro Insecticide SP in 5 gallons of water or 3 to 5 gallons of at least twice refined soybean oil to each 30 tons (60,000 pounds) of seed according to the following rates” in order to achieve a target concentration of 8 ppm. The label specifies that 12.3 ounces of formulation should be used to treat 30 tons of seed in 5 gallons of water (i.e., 0.48 lb ai/5 gallons, 0.48 lb ai/30 tons, or 0.16 lb ai/ton). The label language does not specify particular types of application equipment. Specifically, the label does not preclude the use of open systems to complete seed treatment applications. However, in the January 1998 SMART meeting the registrants indicated that only closed systems are used for admixture seed treatments. As a result, HED has based the

admixture assessment solely on the use of closed systems (**labels should be revised to account for this indication by the registrant**).

Direct animal applications can be made according to current labeling using treated articles (i.e., ear tags). The registrant also proposed an additional application method in the January 1998 SMART meeting that would allow for direct animal pour-on treatments with a ready-to-use liquid. The following information, excerpted from the labels and other information presented by the registrants at the January 1998 SMART meeting as well as data supplied to the Health Effects Division from the Biological and Economic Analysis Division, can be used to describe direct animal pirimiphos methyl applications:

- **Ear Tag Treatment (EPA Regs. 773-68/Dominator Formulation & 773-81/Double Barrel Formulation):** For both formulations, 2 ear tags per animal are used. The Dominator brand ear tag weighs 9.5 grams and contains 20 percent pirimiphos methyl which equates to 3.8 grams ai per animal. The Double Barrel brand ear tag weighs 9.5 grams and contains 14 percent pirimiphos methyl which equates to 2.66 grams ai per animal. Based on information supplied by the registrant, there is only one application per animal per year and the efficacy is approximately 5 months. Also, according to the registrants, “the tags are applied using an ALLFLEX Tagging System.” The labels also indicate that users should “wear nonpermeable protective gloves when applying or removing tags.”
- **Proposed Pour-on Insecticide for Cattle:** The registrants anticipate an average of 1.5 applications per year with this type of product. The proposed labeling indicates that the dose per animal should be “5 mLs per 110 lb of animal body weight” which equates to a rate of 0.0032 lb ai/110 pounds of animal body weight (i.e., 0.017 lb ai/animal based on an average cattle weight of 600 pounds). This value was calculated by HED using a concentration of 2.4 pounds of active ingredient per gallon in the ready-to-use formulation. The proposed label did not specify any protective clothing and only the use of protective eyewear (i.e., goggles). Chemical resistant gloves were not specified. Additionally, according to the registrants at the January 1998 SMART meeting, the application method will be based on a self-totalizing open pour bottle or using a spray trigger device attached directly to the container.

The use of pirimiphos methyl to control mealy bugs on iris bulbs is a very specialized application scenario that is currently only undertaken at a single propagation nursery located in Washington state (EPA SLN WA-9000038 under EPA Reg. 2935-486 -- 5 lb ai/gallon). This SLN specifies direct spray application methods and the use of fogger equipment. The label does not specify any personal protective equipment or engineering controls. According to the nursery management, only fogger applications are made so the HED assessment is focused only on that approach. The label-specified application rate is “60 mL per 10 m³ of cell content.” This equates to the use of 0.080 lb ai/10 m³ of cell content (i.e., 3.63 mg/L or 0.291 ppm). A commercial applicator is used by the nursery to make all applications. According to actual use information for

the years 1991 through 1998, no more than 5 gallons was used for treatments on any single application day throughout that period. The use of a Micro-Gen Model G-4 fogger that is an “ultra low dosage, cold aerosol fogger” was specifically indicated. According to the cutsheet for this device, it is capable of treating up to 500,000 ft³, has a chemical flow rate of 15 to 300 mL/minute, and produces a droplet spectrum in which 95 percent of the droplets are less than 20 microns. The nursery produces up to 20 million bulbs per year and applications are completed on an as needed basis throughout the season of October through July. They indicated that they “do not ship any iris bulbs to retail customers” and “our iris bulbs are used for flower production in our greenhouses, or greenhouses and fields of wholesale customers.” In two letters from the commercial applicators, it was indicated that new Tyvek coveralls and rubber gloves are used to protect the applicators along with a *Self-Contained Breathing Apparatus*(SCBA).

b. Occupational and Residential Exposure/Risk Assessment

HED has determined that there is a potential for exposure from handling pirimiphos methyl products during the application process (i.e., mixer/loaders, applicators, and mixer/loader/applicators) and from entering fumigated greenhouses previously treated with pirimiphos methyl. HED has not identified any homeowner handler or residential postapplication scenarios. As such, exposure assessments have been completed for occupational handler and post-application scenarios.

i. Calculations/Endpoints Used in the Exposure/Risk Assessment

A series of toxicological endpoints and calculations were used to complete the handler and post-application risk assessments. The specifics for calculating handler and post-application exposures differ because of the way that data for each scenario are presented. As such, the endpoints and equations that have been used to calculate exposures/risks for all scenarios are presented in this section.

Toxicological Endpoints: The endpoints that were used to complete this assessment are summarized below in order to provide a quick reference to the occupational handler and postapplication assessments (based on HIARC Report of 4/21/99).

- Short-Term Dermal: 15 mg/kg/day (based on an rat acute oral neurotoxicity study, inhibition of plasma (male and female) and RBC and brain cholinesterase activity);
- Intermediate-Term Dermal: 0.2 mg/kg/day (based on rat subchronic oral study);
- Chronic Dermal: A chronic endpoint is not presented as HED believes that there are no chronic exposure scenarios for pirimiphos methyl.
- Cancer: A cancer risk assessment was not completed because the HIARC concluded that the carcinogenic potential of pirimiphos-methyl cannot be determined due to the lack of an acceptable carcinogenicity study in rats. Also, the HIARC found that a carcinogenicity

study in mice resulted in no evidence of carcinogenicity (MRID No. 43968401). The carcinogenicity study in rats is still considered a toxicological data gap.

- Dermal Absorption: 100 percent (default assumption as no dermal absorption data were available);
- Inhalation Absorption: 100 percent (default assumption as no absorption data were available);
- Inhalation: Acute Inhalation Category IV => 5.04 mg/L are only data available (inhalation exposures are to be combined with dermal to calculate total exposures/risks);
- Body Weight: 60 kg (default assumption for adult females, there are HIARC concerns over pregnant occupational workers); and
- Uncertainty Factors (MOEs): 1000 for short-term (10x for intra-species, 10x for interspecies and 10x for use of LOAEL as well as severity of the effects) and 300 for intermediate-term scenarios (10x for intra-species, 10x for interspecies and 3x for use of LOAEL). The total exposure values are compared to the toxicological endpoints to calculate MOE values.

Handler Exposure/Risk: The daily dermal exposure, daily inhalation exposure, total daily dose, and Margin of Exposure values for handlers were calculated as described below. The first step was to calculate daily dermal exposure using the following formula:

Daily Dermal Exposure (mg ai/day) =

Unit Exposure (mg ai/lb ai) x Application Rate (lb ai/unit) x Daily Treated (units/day)

Where:

Daily Dermal Exposure = Amount deposited on the surface of the skin that is available for dermal absorption, also referred to as potential dose (mg ai/day);

Unit Exposure = Normalized exposure value derived from August 1998 PHED Surrogate Exposure Table, no chemical-specific handler data were available for this assessment (mg ai/pound ai applied);

Application Rate = Normalized application rate based on a logical treatment unit such as tons of grain or on a per animal basis, a maximum value is generally used (e.g., lb ai/animal); and

Daily Treated = Amount that can be treated in a working day, units for normalized of application are based on a logical treatment unit such as tons of grain or numbers of animals (e.g., animals/day).

Daily dermal dose was then calculated by normalizing the daily dermal exposure value by body weight and accounting for dermal absorption (i.e., a biologically available dose resulting from dermal exposure). Daily dermal dose was calculated using the following formula:

$$\text{Daily Dermal Dose} \left(\frac{\text{mg ai}}{\text{kg/day}} \right) = \text{Daily Dermal Exposure} \left(\frac{\text{mg ai}}{\text{day}} \right) \times \left(\frac{\text{DermalAbsorptionFactor}(\%/100)}{\text{Body Weight (kg)}} \right)$$

The next step was to calculate the daily inhalation exposure for handlers. The process used is similar to that used to calculate the daily dermal dose to handlers. Daily inhalation exposure levels were presented as ($\mu\text{g/lb ai}$) values in the PHED Surrogate Exposure Table of August 1998 (i.e., these values are based on an inhalation rate of 29 liters/minute and an 8 hour exposure interval). Once the unit exposure value is presented in this form and converted to (mg/lb ai), the calculations essentially mirror those presented above for the dermal route using a value of 100 percent absorption (i.e., a daily inhalation dose is calculated in mg/kg/day).

The handler exposure assessment does not include any dietary or drinking water inputs.

Finally, the calculations of daily dermal dose and daily inhalation dose received by handlers were then combined to assess the total risk to handlers for each exposure scenario (i.e., MOE or Margin of Exposure is used as the risk expression in this assessment). Short-term MOEs were calculated for total dose levels using a LOAEL of 15 mg/kg/day and intermediate-term MOEs were calculated using the LOAEL of 0.2 mg/kg/day . The short-term and intermediate-term MOEs were calculated using the following formula:

$$MOE = \frac{LOAEL \left(\frac{\text{mg}}{\text{kg/day}} \right)}{\text{Total Daily Dose} \left(\frac{\text{mg}}{\text{kg/day}} \right)}$$

Post-Application Exposure/Risk: HED believes that the potential for dermal postapplication exposure is minimal considering the use patterns associated with pirimiphos methyl (see 4.b.v: *Occupational Postapplication Exposure/Risk Assessment* below for further information and justification). As a result, only postapplication inhalation exposures were calculated for activities associated with the fogging treatment of iris bulbs. This exposure scenario is unique in that it is one in which the use of an application rate coupled with an air exchange factor is used to calculate postapplication risk values. HED also has assumed that even though SCBA devices are available for mitigating inhalation risks (i.e., because the fumigators apparently are not employed by the nursery), that aeration of treated iris bulb storage areas will be used as the primary approach to ensuring that entry into previously treated areas is acceptable. The application rate for the iris bulb fogging is 3.63 mg/L or 0.291 ppm. This value was adjusted by an aeration factor based on HED estimates of air exchange for aeration. The resulting dilute concentration was then converted to a mg/kg/day dose level as described above for applicators and compared to the short- and intermediate-term endpoints. A comparison was also completed using the Category IV inhalation NOAEL concentration.

ii. Handler Risk Assessment Assumptions and Factors

A series of assumptions and exposure factors served as the basis for completing the handler risk assessment. These are described below:

- Average body weight of an adult handler is 60 kg (HED default for adult females).
- Language contained on several labels did not coincide with the practices described in the January 1998 SMART meeting (e.g., closed systems are not required for seed treatment when the label is strictly interpreted). **As a result, HED based several assessments on the intended practices described in the SMART meeting with the stipulation that the label language is revised to reflect these changes.** These include the use of closed admixture stored grain and seed treatment devices; the elimination of nonfogging applications from the iris bulb SLN label; use of closed handling/package systems for handling grain/seed in admixture treatments; and the specification of SCBA devices with an assigned NIOSH protection factor of at least 10,000 (tight fitting face piece with self contained air tank/PF = 10,000; a configuration with tight fitting face piece and supplied air line/PF = 2,000 would also be considered).
- All animal use scenarios were assumed to treat 200 animals per day. For the admixture stored grain and seed treatments, daily totals of 500 tons for stored grain and 100 tons for seed were assumed. Actual chemical use data were available for the iris bulb treatments at the nursery in Washington state for the years 1991 through 1998. In all cases, the daily amount applied did not exceed 5 gallons and in most cases was in the 1 to 3 gallon range. As a result, HED used a value of 5 gallons for the iris bulb fogging applications. When top dressing applications were assessed, HED assumed that 5 bins would be treated in a day and that the cross-sectional area treated would be 1000 ft² (i.e., approximately 32 feet by 32 feet) for a daily surface area treated of 5,000 ft². Likewise, when the bin disinfestation treatment was considered, a total surface area of 11,000 ft² was assumed based on treating three cylindrical grain elevators daily (i.e., each 15 feet in diameter and 75 feet high).
- All handler calculations were completed at the maximum labeled application rate for each scenario (refer to Section 4a). This is a reasonable approach given that available labels do not allow for large differences between the minimum and maximum application rates (i.e., risk levels are not anticipated to be very sensitive to changes in this parameter). Treated cattle were assumed to weigh 600 pounds in order to calculate animal treatment dose levels. The average cattle weight was determined based on an assessment of cattle weight gain during the finishing process (i.e., a 600 pound animal is early on in the finishing process which would correspond to direct animal treatments).
- Due to a lack of scenario-specific data, HED is often forced to calculate unit exposure values using generic protection factors that are applied to represent various risk mitigation

options (i.e., the use of PPE or Personal Protective Equipment and engineering controls). PPE protection factors include those representing layers of clothing (50%), chemical-resistant gloves (90%), and respiratory protection (PF = 5 to PF = 10,000 depending upon mitigation option is selected). Engineering controls are generally assigned a protection factor of 90 percent. Engineering controls may include closed mixing/loading systems and closed cabs/cockpits.

iii. Occupational Handler Exposure/Risk Assessment

HED has determined that exposure to pesticide handlers is likely during the occupational use of pirimiphos-methyl in a variety environments including agriculture and in commercial/industrial premises (e.g., grain storage facilities and loading/shipping facilities). There are no apparent homeowner handler or residential application scenarios. The anticipated use patterns and current labeling indicate 7 major occupational exposure scenarios based on the types of equipment and techniques that can potentially be used to make applications. These 7 scenarios serve as the basis for the quantitative exposure/risk assessment developed for pirimiphos-methyl occupational handlers. These scenarios include:

- (1a) closed system mixing/loading liquids for admixture grain treatment;
- (1b) closed system mixing/loading liquids for seed treatment;
- (1c) open mixing/loading of liquid for fogging treatment of iris bulbs;
- (2) fogging treatment of iris bulbs;
- (3) applying cattle ear tags;
- (4a) applying the ready-to-use formulation to livestock using a self-totalizing pour-on package;
- (4b) applying the ready-to-use formulation to livestock using a trigger sprayer package;
- (5) mixing/loading/applying with a low pressure handwand sprayer (top-dress and proposed bin disinfestation scenarios are assessed);
- (6) mixing/loading/applying with a backpack sprayer (top-dress and proposed bin disinfestation scenarios are assessed); and
- (7) mixing/loading/applying with high pressure handwand sprayer (top-dress and proposed bin disinfestation scenarios are assessed).

[Note: Only closed system mixing/loading liquids were considered for the admixture grain and seed treatments. **Potential exposure due to handling/packaging treated grains and seed were not considered by HED because the registrants indicated that closed systems are the norm (this must be reflected in label changes based on the RED).** Open loading was only considered for the fogging scenario as HED has very specific data that indicate that no closed loading occurs. The scenarios that are assessed for the top-dress treatments do not account for the required raking in step.]

Chemical-specific data for assessing human exposures during pesticide handling activities were not submitted to the Agency in support of the (re)registration of pirimiphos methyl. It is the policy of the HED to use data from the Pesticide Handlers Exposure Database (PHED) Version

1.1 to assess handler exposures for regulatory actions when chemical-specific monitoring data are not available.

PHED was designed by a task force of representatives from the U.S. EPA, Health Canada, the California Department of Pesticide regulation, and member companies of the American Crop Protection Association. PHED is a software system consisting of two parts -- a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates).

Users select criteria to subset the PHED database to reflect the exposure scenario being evaluated. The subsetting algorithms in PHED are based on the central assumption that the magnitude of handler exposures to pesticides are primarily a function of activity (e.g., mixing/loading, applying), formulation type (e.g., wettable powders, granulars), application method (e.g., aerial, groundboom), and clothing scenarios (e.g., gloves, double layer clothing).

Once the data for a given exposure scenario have been selected, the data are normalized (i.e., divided by) by the amount of pesticide handled resulting in standard unit exposures (milligrams of exposure per pound of active ingredient handled). Following normalization, the data are statistically summarized. The distribution of exposure values for each body part (e.g., chest upper arm) is categorized as normal, lognormal, or “other” (i.e., neither normal nor lognormal). A central tendency value is then selected from the distribution of the exposure values for each body part. These values are the arithmetic mean for normal distributions, the geometric mean for lognormal distributions, and the median for all “other” distributions. Once selected, the central tendency values for each body part are composited into a “best fit” exposure value representing the entire body.

The unit exposure values calculated by PHED generally range from the geometric mean to the median of the selected data set. To add consistency and quality control to the values produced from this system, the PHED Task Force has evaluated all data within the system and has developed a set of grading criteria to characterize the quality of the original study data. The assessment of data quality is based on the number of observations and the available quality control data. These evaluation criteria and the caveats specific to each exposure scenario are summarized in Table XIII. While data from PHED provide the best available information on handler exposures, it should be noted that some aspects of the included studies (e.g., duration, acres treated, pounds of active ingredient handled) may not accurately represent labeled uses in all cases. HED has developed a series of tables of standard unit exposure values for many occupational scenarios that can be utilized to ensure consistency in exposure assessments.

There are three basic risk mitigation approaches considered appropriate for controlling occupational exposures. These include administrative controls, the use of personal protective equipment or PPE, and the use of engineering controls. Occupational handler exposure assessments are completed by HED using a baseline exposure scenario and, if required, increasing

levels of risk mitigation (PPE and engineering controls) to achieve an appropriate margin of exposure or cancer risk. [Note: Administrative controls available generally involve altering application rates for handler exposure scenarios. These are typically not utilized for completing handler exposure assessments because of the negotiation requirements with registrants.] The baseline clothing/PPE ensemble for occupational exposure scenarios is generally an individual wearing long pants, a long-sleeved shirt, no chemical-resistant gloves (there are exceptions pertaining to the use of gloves and these are noted), and no respirator. The first level of mitigation generally applied is PPE. As reflected in the calculations included herein, PPE involves the use of an additional layer of clothing, chemical-resistant gloves, and a respirator. The next level of mitigation considered in the risk assessment process is the use of appropriate engineering controls which, by design, attempt to eliminate the possibility of human exposure. Examples of commonly used engineering controls include closed tractor cabs, closed mixing/loading/transfer systems, and water-soluble packets.

The exposure/risk assessment that has been completed for the occupational handler scenarios is presented in Tables IX through XIII. HED anticipates that occupational pirimiphos methyl exposures will only occur in a short-term or intermediate-term pattern. HED anticipates that occupational exposures will not be chronic because HED defines chronic exposures as use of the chemical for approximately 180 days per year and it is anticipated that pirimiphos methyl as with other typical pesticide compounds will not be used in this manner. Intermediate-term risks are included in this document, even though HED believes that the likelihood of an intermediate-term exposure pattern is somewhat unlikely given the intent of most pirimiphos methyl applications. There are notable exceptions including seed treatments and potential animal uses.

Table IX presents the dermal and inhalation unit exposures for each occupational handler exposure scenario at all levels of mitigation (i.e., baseline, use of personal protective clothing, and engineering controls). [Note: There are no currently registered homeowner uses of pirimiphos methyl.] Also included in Table IX are the application parameters that are used including maximum application rates and areas treated for each exposure scenario.

Table X presents MOEs (Margin of Exposure values) at the baseline exposure scenario (e.g., long pants, long-sleeved shirts, no chemical-resistant gloves -- with exceptions as noted due to the available empirical data). Table XI presents MOEs for the PPE exposure scenario (e.g., extra layer of clothing, respirator, and chemical-resistant gloves). Table XII presents MOEs for the engineering control exposure scenario (e.g., closed cab or closed mixing systems). Tables X through XII also illustrate the procedures used to calculate the MOE values for each level of mitigation. Included in each table are the daily exposures (mg/day) attributable to the dermal and inhalation routes (i.e., dietary and water intakes for occupational handlers are not included in this assessment); absorbed daily dose for those routes; and the total absorbed daily dose levels used in the MOE calculations.

No empirical data for inhalation exposure data were available to complete an assessment for the iris bulb fogging treatment scenario is based on the typical HED approach for calculating

exposures. The fogging application rate (not accounting for any dilution) results in an airborne concentration of 3.63 mg/L. If the NIOSH protection factor for a tight-fitting SCBA is applied to this value the resulting exposure concentration is 0.00036 mg/L which is 5 orders of magnitude less than the Category IV acute inhalation toxicity concentration. Dermal exposures are not the primary concern for this application scenario considering the use of Tyvek coveralls and gloves (along with SCBA). This approach is acceptable in this instance to HED because this assessment is site-specific in nature and the use pattern is extremely limited in scope. Additionally, there is precedent by other agencies such as OSHA for utilizing this type of risk mitigation approach for site-specific scenarios. See the risk characterization for this scenario described in Section 4.c for further information.

Table IX. Numerical Inputs Used For Pirimiphos Methyl Handler Exposure Assessment

No.	Exposure Scenario	Unit Exposures						Application Parameters	
		Baseline ^a		Additional PPE ^b		Engineering Controls ^c			
		Dermal (mg/lb ai)	Inhalation (μ g/lb ai)	Dermal (mg/lb ai)	Inhalation (μ g/lb ai)	Dermal (mg/lb)	Inhalation (μ g/lb)	Application Rates (ai/unit) ^d	Maximum Treated (units/day) ^e
Mixer/Loaders									
1a	Mixing/loading Liquids For Admixture Grain Treatment	N/F	N/F	N/F	N/F	0.0086 (gloves)	0.083	0.012 lb ai/ton (min) 0.016 lb ai/ton (max)	500 tons
1b	Mixing/loading Liquids For Seed Treatment							0.016 lb ai/ton	100 tons
1c	Loading Liquids For Fogging Treatment of Iris Bulbs ^f	2.9	1.2	0.017	0.12	N/F	N/F	3.63 mg/L	5 gallons/day (25 lb ai)
Applicators									
2	Fogging Treatment of Iris Bulbs ^f	N/F	N/F	No Data	No Data	N/F	N/F	3.63 mg/L	5 gallons/day (25 lb ai)
3	Cattle Ear Tags	No Data	No Data	No Data	No Data	N/F	N/F	2.7 g ai/animal to 3.8 g ai/animal	200 animals/day
4a	RTU Solution on Cattle Using a Self-Totalizing Pour-On Package	2.9	1.2	0.017	0.12	N/F	N/F	0.017 lb ai/animal	200 animals/day
4b	RTU Solution on Cattle Using a Trigger Sprayer Package	No Data	No Data	No Data	No Data	N/F	N/F		
Mixer/Loader/Applicators									
5	Mixing/loading and Applying Liquids Using a Low Pressure Handwand Sprayer	100	30	0.36	3.0	N/F	N/F	0.12 lb ai/1,000 ft ² (top dress)	5,000 ft ² /day (top dress)
6	Mixing/loading and Applying Liquids Using a Backpack Sprayer	2.5 (gloves)	30	1.6	3.0	N/F	N/F	0.10 lb ai/1,000 ft ² (bin disinfestation)	11,000 ft ² /day (bin disinfestation)
7	Mixing/loading and Applying Liquids Using a High Pressure Handwand Sprayer	2.5 (gloves)	120	1.6	12	N/F	N/F		

"No Data" indicates that no appropriate data are available for incorporation into this cell. "N/F" indicates that this exposure scenario is not considered feasible by HED due to engineering or other practical considerations (e.g., an open cockpit aerial application scenario is not considered feasible as aircraft appropriate for this use are not manufactured with open cockpits).

- a Baseline clothing and PPE scenario: Workers wearing single layer clothing, no gloves, and no respirator. Mixing/loading activities are open. Also open cab for applicators and flaggers. Exceptions are noted on an individual basis.
- b PPE: Workers typically wear double layer of clothing, chemical resistant gloves, and respirator. Exceptions are noted on an individual basis.
- c Engineering controls: Workers wearing single layer clothing and no gloves while using an appropriate engineering control system (e.g., closed mixing, enclosed cabs).
- d See Section 4.a.iv for derivation of application rates. Application rates for all handler scenarios are maximums allowed by label.
- e HED believes these values represent a reasonable estimation of the median to upper percentile of what can be treated in a single day based on the exposure scenario of concern. Users of this table are cautioned to note that these values are based on professional judgement when appropriate data are not available.

- f Application rate and amount treated are based on use data from single nursery that uses pirimiphos methyl under this SLN. No applicator inhalation exposure value is available but an assessment has been completed using the application rate and the application of a protection factor for the use of a self contained breathing apparatus (PF = 10,000). [See Section 4.b for further information.]

Table X. Exposures and Risks For Occupational Pirimiphos Methyl Handlers At The Baseline Clothing Scenario

No.	Exposure Scenario	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b			Short-Term Risk (MOE) ^c	Intermediate-Term Risk (MOE) ^d
		Dermal	Inhalation	Dermal	Inhalation	Total		
Mixer/Loaders								
1a	Mixing/loading Liquids For Admixture Grain Treatment	N/F	N/F	N/F	N/F	N/F	N/F	N/F
1b	Mixing/loading Liquids For Seed Treatment	N/F	N/F	N/F	N/F	N/F	N/F	N/F
1c	Loading Liquids For Fogging Treatment of Iris Bulbs	73	0.030	1.2	0.00050	1.2	13	<1
Applicators								
2	Fogging Treatment of Iris Bulbs	N/F	N/F	N/F	N/F	N/F	N/F	N/F
3	Cattle Ear Tags	No Data	No Data	No Data	No Data	No Data	No Data	No Data
4a	RTU Solution on Cattle Using a Self-Totalizing Pour-On Package	9.9	0.0041	0.17	0.000068	0.17	88	1
4b	RTU Solution on Cattle Using a Trigger Spray Package	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Mixer/Loader/Applicator								
5	Mixing/loading and Applying Liquids Using a Low Pressure Handwand	60 (Top Dress)	0.018	1.0	0.00030	1.0	15	<1
		110 (Bin Disinfestation)	0.033	1.8	0.00055	1.8	8	<1
6	Mixing/loading and Applying Liquids Using a Backpack Sprayer	1.5 (Top Dress)	0.018	0.025	0.00030	0.025	600	8
		2.8 (Bin Disinfestation)	0.033	0.046	0.00055	0.046	330	4
7	Mixing/loading and Applying Liquids Using a High Pressure Handwand	1.5 (Top Dress)	0.072	0.025	0.0012	0.026	580	8
		2.8 (Bin Disinfestation)	0.13	0.047	0.0022	0.049	310	4

MOE <1000 indicates risk concern for short-term scenarios and MOE<300 indicate a risk concern for intermediate-term scenarios.

“No Data” indicates that no appropriate data are available for incorporation into this cell. “N/F” indicates that this exposure scenario is not considered feasible by HED due to engineering or other practical considerations (e.g., an open cockpit aerial application scenario is not considered feasible as aircraft appropriate for this use are not manufactured with open cockpits). N/A indicates that an appropriate risk level has been obtained and there is no need for imposition of a more protective level of risk mitigation. Appropriate risk levels are indicated in individual cells in the tables by **bolding** the numerical value.

a Daily dermal exposure (mg/day) = Exposure (mg/lb ai) * Appl. Rate (lb ai/unit) * Treated (units).

Daily inhalation exposure (mg/day) = Exposure (μg/lb ai) * (1mg/1000ug) unit conversion * Appl Rate (lb ai/unit) * Treated (units).

b Absorbed daily dermal dose = daily dermal exposure (mg/day) * dermal absorption (100%) / body weight (60 kg).

Absorbed daily inhalation dose = daily inhalation exposure (mg/day) / body weight (60 kg). [Assumes 100 percent absorption.]

Total absorbed daily dose = absorbed daily dermal dose + absorbed daily inhalation dose.

c Short-Term MOE = LOAEL (15 mg/kg/day)/absorbed daily dose (mg/kg/day). MOEs < 1000 indicate a risk concern.

d Intermediate-Term MOE = LOAEL (0.2 mg/kg/day)/absorbed daily dose (mg/kg/day). MOEs < 300 indicate a risk concern.

Table XI. Exposures and Risks For Pirimiphos Methyl Handlers Using Protective Clothing and PPE To Mitigate Exposures.

No.	Exposure Scenario	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b			Short-Term Risk (MOE) ^c	Intermediate-Term Risk (MOE) ^d
		Dermal	Inhalation	Dermal	Inhalation	Total		
Mixer/Loaders								
1a	Mixing/loading Liquids For Admixture Grain Treatment	N/F	N/F	N/F	N/F	N/F	N/F	N/F
1b	Mixing/loading Liquids For Seed Treatment	N/F	N/F	N/F	N/F	N/F	N/F	N/F
1c	Loading Liquids For Fogging Treatment of Iris Bulbs	0.43	0.0030	0.0072	0.000050	0.0073	2100	27
Applicators								
2	Fogging Treatment of Iris Bulbs	No Data	See Section 4.b	No Data	See Section 4.b	See Section 4.b	See Section 4.b	See Section 4.b
3	Cattle Ear Tags	No Data	No Data	No Data	No Data	No Data	No Data	No Data
4a	RTU Solution on Cattle Using a Self-Totalizing Pour-On Package	0.058	0.00041	0.00097	0.0000068	0.00098	15000	200
4b	RTU Solution on Cattle Using a Trigger Spray Package	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Mixer/Loader/Applicator								
5	Mixing/loading and Applying Liquids Using a Low Pressure Handwand	0.22 (Top Dress)	0.0018	0.0036	0.000030	0.0036	4200	55
		0.40 (Bin Disinfestation)	0.0033	0.0066	0.000055	0.0066	2300	30
6	Mixing/loading and Applying Liquids Using a Backpack Sprayer	0.96 (Top Dress)	0.0018	0.016	0.000030	0.016	940	13
		1.8 (Bin Disinfestation)	0.0033	0.03	0.000055	0.03	500	7
7	Mixing/loading and Applying Liquids Using a High Pressure Handwand	0.96 (Top Dress)	0.0072	0.016	0.00012	0.016	940	13
		1.8 (Bin Disinfestation)	0.013	0.029	0.00022	0.029	500	7

MOE <1000 indicates risk concern for short-term scenarios and MOE<300 indicate a risk concern for intermediate-term scenarios.

“No Data” indicates that no appropriate data are available for incorporation into this cell. “N/F” indicates that this exposure scenario is not considered feasible by HED due to engineering or other practical considerations (e.g., an open cockpit aerial application scenario is not considered feasible as aircraft appropriate for this use are not manufactured with open cockpits). N/A indicates that an appropriate risk level has been obtained and there is no need for imposition of a more protective level of risk mitigation. Appropriate risk levels are indicated in individual cells in the tables by **bolding** the numerical value.

a Daily dermal exposure (mg/day) = Exposure (mg/lb ai) *Appl. Rate (lb ai/unit) * Treated (units).

Daily inhalation exposure (mg/day) = Exposure (μg/lb ai) * (1mg/1000ug) unit conversion * Appl Rate (lb ai/unit) * Treated (units).

b Absorbed daily dermal dose = daily dermal exposure (mg/day) * dermal absorption (100%) / body weight (60 kg).

Absorbed daily inhalation dose = daily inhalation exposure (mg/day) / body weight (60 kg). [Assumes 100 percent absorption.]

Total absorbed daily dose = absorbed daily dermal dose + absorbed daily inhalation dose.

c Short-Term MOE = LOAEL (15 mg/kg/day)/absorbed daily dose (mg/kg/day). MOEs < 1000 indicate a risk concern.

d Intermediate-Term MOE = LOAEL (0.2 mg/kg/day)/absorbed daily dose (mg/kg/day). MOEs < 300 indicate a risk concern.

Table XII. Exposures and Risks For Pirimiphos Methyl Handlers Using Engineering Controls To Mitigate Exposures

No.	Exposure Scenario	Daily Exposure (mg/day) ^a		Absorbed Daily Dose (mg/kg/day) ^b			Short-Term Risk (MOE) ^c	Intermediate-Term Risk (MOE) ^d
		Dermal	Inhalation	Dermal	Inhalation	Total		
Mixer/Loaders								
1a	Mixing/loading Liquids For Admixture Grain Treatment	0.052 (min. rate)	0.00050	0.00087	8.3 e-6	0.00087	17000	240
		0.069 (max. rate)	0.00066	0.0011	1.1 e-5	0.0011	14000	180
1b	Mixing/loading Liquids For Seed Treatment	0.013	0.00013	0.00022	2.2 e-6	0.00022	68000	910
1c	Loading Liquids For Fogging Treatment of Iris Bulbs	N/F	N/F	N/F	N/F	N/F	N/F	N/F
Applicators								
2	Fogging Treatment of Iris Bulbs	N/F	N/F	N/F	N/F	N/F	N/F	N/F
3	Cattle Ear Tags	N/F	N/F	N/F	N/F	N/F	N/F	N/F
4a	RTU Solution on Cattle Using a Self-Totalizing Pour-On Package	N/F	N/F	N/F	N/F	N/F	N/F	N/F
4b	RTU Solution on Cattle Using a Trigger Spray Package	N/F	N/F	N/F	N/F	N/F	N/F	N/F
Mixer/Loader/Applicator								
5	Mixing/loading and Applying Liquids Using a Low Pressure Handwand	N/F	N/F	N/F	N/F	N/F	N/F	N/F
6	Mixing/loading and Applying Liquids Using a Backpack Sprayer	N/F	N/F	N/F	N/F	N/F	N/F	N/F
7	Mixing/loading and Applying Liquids Using a High Pressure Handwand	N/F	N/F	N/F	N/F	N/F	N/F	N/F

MOE <1000 indicates risk concern for short-term scenarios and MOE<300 indicate a risk concern for intermediate-term scenarios.

"No Data" indicates that no appropriate data are available for incorporation into this cell. "N/F" indicates that this exposure scenario is not considered feasible by HED due to engineering or other practical considerations (e.g., an open cockpit aerial application scenario is not considered feasible as aircraft appropriate for this use are not manufactured with open cockpits). N/A indicates that an appropriate risk level has been obtained and there is no need for imposition of a more protective level of risk mitigation. Appropriate risk levels are indicated in individual cells in the tables by **bolding** the numerical value.

a Daily dermal exposure (mg/day) = Exposure (mg/lb ai) *Appl. Rate (lb ai/unit) * Treated (units).

Daily inhalation exposure (mg/day) = Exposure (μg/lb ai) * (1mg/1000ug) unit conversion * Appl Rate (lb ai/unit) * Treated (units).

b Absorbed daily dermal dose = daily dermal exposure (mg/day) * dermal absorption (100%) / body weight (60 kg).

Absorbed daily inhalation dose = daily inhalation exposure (mg/day) / body weight (60 kg). [Assumes 100 percent absorption.]

Total absorbed daily dose = absorbed daily dermal dose + absorbed daily inhalation dose.

c Short-Term MOE = LOAEL (15 mg/kg/day)/absorbed daily dose (mg/kg/day). MOEs < 1000 indicate a risk concern.

d Intermediate-Term MOE = LOAEL (0.2 mg/kg/day)/absorbed daily dose (mg/kg/day). MOEs < 300 indicate a risk concern.

Table XIII. Exposure Scenario Descriptions For Occupational Pirimiphos Methyl Handlers

No.	Exposure Scenarios	Data Source	Clothing/PPE/Equipment Use Descriptions			Standard Assumptions (8-hr work day) ^a	Comments ^{b,c}
			Baseline	PPE	Engineering Controls		
Mixer/Loaders							
1a/1b	Mixing/loading Liquids for Admixture Grain Treatment & Mixing/loading Liquids for Seed Treatment	PHED V1.1 (Aug 1998 Surrogate Table)	Not considered as a feasible alternative for this assessment as registrant indicated only closed systems are used. Label should be altered to reflect this assumption.	Not considered as a feasible alternative for this assessment as registrant indicated only closed systems are used. Label should be altered to reflect this assumption.	Single layer clothing, chemical resistant gloves (only empirical data available) , no respirator, and closed mixing system.	500 tons/day can be treated in admixture grain treatments and 100 tons/day can be treated in seed treatments	<p>Baseline: Not feasible, since the registrants indicated that a baseline clothing or PPE scenario would not be appropriate at the January 1998 SMART meeting. All mixing/loading is to be completed using closed systems -- the labels need revised to reflect this stipulation.</p> <p>PPE: Not feasible, since the registrants indicated that a baseline clothing or PPE scenario would not be appropriate at the January 1998 SMART meeting. All mixing/loading is to be completed using closed systems -- the labels need revised to reflect this stipulation.</p> <p>Engineering Control: Hand and inhalation = acceptable grades; and dermal = ABC grade. Dermal = 30 to 36 replicates; hand = 31 replicates; and inhalation = 27 replicates. High confidence in hand and inhalation data. Medium confidence in dermal data. No protection factors were used for this assessment (unit exposure is based on use of protective gloves -- only empirical data available).</p>
1c	Loading Liquids For Fogging Treatment of Iris Bulbs	PHED V1.1 (August 1998 Surrogate Table)	Single layer clothing, no chemical resistant gloves, no respirator, and open loading	Double layer clothing, chemical resistant gloves, respirator, and open loading	Not considered as a feasible alternative for this assessment as registrant indicated that a particular fogger device was used that did not allow for closed mixing/loading scenarios.	5 gallons per day based on actual use information indicating that up to 4 gallons per day were applied on a routine basis.	<p>Baseline: Hand, dermal, and inhalation are acceptable grades. Hand - 53 replicates; dermal = 71 to 121 replicates; and inhalation = 85 replicates. High confidence in dermal/hand and inhalation data. No protection factors were needed to define any unit exposure value.</p> <p>PPE: The same dermal and inhalation data are used as for the baseline assessment coupled with a 50% protection factor to account for an additional layer of clothing and a 90% protection factor to account for the use of a respirator. A protection factor was not required for the hand assessment. Hands = acceptable grades. Hands = 59 replicates. High confidence in hand data. According to the registrants, the fumigation company at the nursery that completes these applications uses self-contained breathing apparatus (SCBA) for respiratory protection. These devices have a protection factor of 10,000 (i.e., this would significantly reduce the inhalation exposure component --it does not reduce overall exposure levels as a majority is due to the dermal route).</p> <p>Engineering Controls: Not feasible, since the Agency does not consider engineering controls an effective approach for mitigating exposures during the use of the fogging equipment.</p>

No.	Exposure Scenarios	Data Source	Clothing/PPE/Equipment Use Descriptions			Standard Assumptions (8-hr work day) ^a	Comments ^{b,c}
			Baseline	PPE	Engineering Controls		
Applicators							
2	Fogging Treatments of Iris Bulbs	Theoretical Exposure Concentration Calculated Based on Label Application Rate	Not considered as a feasible alternative for this assessment as registrant indicated that a particular clothing/PPE scenario is used during fogging events.	Tyvek coverall over normal work clothing, disposable rubber gloves, and SCBA (self-contained breathing apparatus -- tight fitting facepiece is assumed with a protection factor of 10,000)	Not considered as a feasible alternative for this assessment as registrant indicated that a particular clothing/PPE scenario is used during fogging events.	5 gallons per day based on actual use information indicating that up to 4 gallons per day were applied on a routine basis	No empirical data are available for this scenario, instead, the maximum application rate served as the basis for this assessment. This assessment must be considered only for use as a rangefinder using extremely low confidence data because of the extrapolation that has been completed. See the risk characterization discussion presented in Section 4c. Pirimiphos methyl is Category IV for inhalation toxicity. When this is considered, along with requirements for SCBA use, HED believes that risks due to inhalation exposure in this scenario should be minimal. It should also be considered that the mitigated exposure concentration is 5 orders of magnitude less than the acute inhalation NOAEL concentration. The HAZ ID document indicated that inhalation exposure levels should be added to the dermal dose and compared to the appropriate endpoint (i.e., chronic NOAEL used for short- and intermediate-term assessments). When calculated in this manner, the MOE is approximately 10 -- this is not an appropriate route-to-route extrapolation for this scenario.
3	Cattle Ear Tags	No Data	No Data	No Data	Not Feasible	200 animals/day (2 tags/animal)	No Data
4a	RTU Solution on Cattle Using a Self-Totalizing Pour-on Package	See 1c above	See 1c above	See 1c above	Not Feasible	200 animals/day	No empirical data are available for this scenario, instead, mixing/loading of liquids data were used. This assessment must be considered only for use as a rangefinder using extremely low confidence data because of the extrapolation that has been completed. See the risk characterization discussion presented in Section 4c. For information purposes only, refer to summary of the mixer/loader data presented above (see scenario 1c).
4b	RTU Solution on Cattle Using a Trigger Spray Package	No data	No data	No data	Not Feasible	200 animals/day	No data

No.	Exposure Scenarios	Data Source	Clothing/PPE/Equipment Use Descriptions			Standard Assumptions (8-hr work day) ^a	Comments ^{b,c}
			Baseline	PPE	Engineering Controls		
Mixer/Loader/Applicator							
5	Mixing/loading and Applying Liquids Using a Low Pressure Handwand Sprayer	PHED V1.1 (August 1998 Surrogate Table)	Single layer clothing, no chemical resistant gloves, no respirator, and open mixing.	Double layer clothing, chemical resistant gloves, respirator, and open mixing.	Not considered feasible by Agency	0.12 lb ai/1000 ft ² for top dress treatments where 5000 ft ² are treated per day (5-1000 ft ² cross sections/day) 0.10 lb ai/1000 ft ² for bin disinfection treatments where 11000 ft ² are treated per day (3-15ft diameter by 75 feet high elevators)	Baseline: Hands = all grade. Dermal and inhalation = ABC grades. Hands = 70 replicates; dermal = 9 to 80 replicates; and inhalation = 80 replicates. Low confidence in hand/dermal data. Medium confidence in inhalation data. No protection factors were required to define the unit exposures. PPE: The same dermal data for baseline were used coupled with a 50% protection factor to account for an additional layer of clothing. A 90% protection factor was also applied to the baseline inhalation data to account for the use of a respirator. Hands = ABC grades. Hands = 10 replicates. Low confidence in hand data. Engineering Controls: Not feasible, since the Agency does not consider engineering controls an effective approach for mitigating exposures during the use of the equipment. Assessments do not account for additional exposures expected from raking-in procedure.
6	Mixing/loading and Applying Liquids Using a Backpack Sprayer	PHED V1.1 (August 1998 Surrogate Table)	Single layer clothing, chemical resistant gloves (only empirical data available) , no respirator, and open mixing	Double layer clothing, chemical resistant gloves, respirator, and open mixing.	Not considered feasible by Agency	0.12 lb ai/1000 ft ² for top dress treatments where 5000 ft ² are treated per day (5-1000 ft ² cross sections/day) 0.10 lb ai/1000 ft ² for bin disinfection treatments where 11000 ft ² are treated per day (3-15ft diameter by 75 feet high elevators)	Baseline: Hands = ABC grade. Dermal and inhalation = Acceptable grades. Hands = 11 replicates; dermal = 9 to 11 replicates; and inhalation = 11 replicates. Low confidence in hand data. Medium confidence in dermal and inhalation data. No protection factors were required to define the unit exposures (unit exposure is based on use of protective gloves -- only empirical data available). PPE: The same dermal and hand data for baseline were used coupled with a 50% protection factor to account for an additional layer of clothing. A 90% protection factor was also applied to the baseline inhalation data to account for the use of a respirator. Engineering Controls: Not feasible, since the Agency does not consider engineering controls an effective approach for mitigating exposures during the use of the equipment. Assessments do not account for additional exposures expected from raking-in procedure.
7	Mixing/loading and Applying Liquids Using a High Pressure Handwand	PHED V1.1 (August 1998 Surrogate Table)	Single layer clothing, chemical resistant gloves (only empirical data available) , no respirator, and open mixing.	Double layer clothing, chemical resistant gloves, respirator, and open mixing.	Not considered feasible by the Agency	0.12 lb ai/1000 ft ² for top dress treatments where 5000 ft ² are treated per day (5-1000 ft ² cross sections/day) 0.10 lb ai/1000 ft ² for bin disinfection treatments where 11000 ft ² are treated per day (3-15ft diameter by 75 feet high elevators)	Baseline: Hands = ABC grade. Dermal and inhalation = Acceptable grades. Hands = 13 replicates; dermal = 7 to 13 replicates; and inhalation = 13 replicates. Low confidence in hand data. Medium confidence in dermal and inhalation data. No protection factors were required to define the unit exposures (unit exposure is based on use of protective gloves -- only empirical data available). PPE: The same dermal and hand data for baseline were used coupled with a 50% protection factor to account for an additional layer of clothing. A 90% protection factor was also applied to the baseline inhalation data to account for the use of a respirator. Engineering Controls: Not feasible, since the Agency does not consider engineering controls an effective approach for mitigating exposures during the use of the equipment. Assessments do not account for additional exposures expected from raking-in procedure.

a

All Standard Assumptions are based on an 8-hour work day as estimated by HED. BEAD data were not available.

- b All handler exposure assessments in this document are based on the "Best Available" data as defined by the PHED SOP for meeting Subdivision U Guidelines (i.e., completing exposure assessments). Best available grades are assigned to data as follows: matrices with A and B grade data (i.e., Acceptable Grade Data) and a minimum of 15 replicates; if not available, then grades A, B and C data and a minimum of 15 replicates; if not available, then all data regardless of the quality (i.e., All Grade Data) and number of replicates. High quality data with a protection factor take precedence over low quality data with no protection factor. Generic data confidence categories are assigned as follows:
- High = grades A and B and 15 or more replicates per body part
Medium = grades A, B, and C and 15 or more replicates per body part
Low = grades A, B, C, D and E or any combination of grades with less than 15 replicates.
- c **PHED grading criteria do not reflect overall quality of the reliability of the assessment. Sources of the exposure factors should also be considered in the risk management decision.**

iv. Homeowner Handler Exposure/Risk Assessment

There are currently no products containing pirimiphos methyl that are marketed for sale to homeowners. As such, no exposure/risk analysis was completed for these use scenarios.

v. Occupational Post-Application Exposure/Risk Assessment

The following was considered during the development of the occupational postapplication risk assessment:

- postapplication exposures from ear tags is expected to be minimal because chemical-resistant gloves are to be worn during removal and disposal of exhausted tags (HED believes that the use of gloves in this case is an appropriate postapplication exposure mitigation approach) and it is unlikely that ear tags will be removed until a significant percentage of the pirimiphos methyl concentration has declined;
- direct animal treatments (other than eartags) are not anticipated to have a significant postapplication exposure potential because of the duration between application and animal handling (e.g., PHI requirements) and any contact would be minimal;
- currently labeled grain and seed treatments are anticipated to have a low postapplication exposure potential because material handling is expected to be done mechanically and because of the intent of pirimiphos methyl applications (i.e., treat and ensure low infestations over long-term storage which allows ample time for dissipation);
- iris bulb treatments are anticipated to have a low postapplication exposure potential because “all treated iris bulbs are stored for a minimum of at least 3 to 4 weeks and normally the bulbs are stored between 8 to 12 weeks after treatment”; and
- treated iris bulbs “from the date of the last treatment may be moved to a different temperature control room via forklift. Those that are shipped are transported via temperature controlled trucks after being loaded by forklift. They are planted by machines or machine-assisted hand planting. The hand planting crew is required to wear protective gloves” (HED believes that the use of gloves in this case is an appropriate postapplication exposure mitigation approach).

Given the above information, HED believes that the iris bulb fogging scenario represents the most significant potential for postapplication exposure because of the associated cultural practices. Dermal exposures were not considered in this assessment because dermal contact with treated bulbs is expected to be minimal (mechanical planting or assistance and glove use for hand planters) and due to the storage interval prior to bulb use (“at least 3 to 4 weeks”). With this as a premise, HED has concerns only related to post-fogging ventilation procedures that would be expected to occur in the short-term after fogging operations. It is believed that the principal exposure route for this scenario will be inhalation. Empirical inhalation exposure data were not available to complete a postapplication exposure assessment for the iris bulb fogging treatment scenario. The fogging application rate (not accounting for any dilution) results in an airborne concentration of 3.63 mg/L. If the NIOSH protection factor for a tight-fitting SCBA is applied to

this value the resulting exposure concentration is 0.00036 mg/L which is 5 orders of magnitude less than the Category IV acute inhalation toxicity concentration (as described above for the handler calculations). However, it is not clear from the available use information if the SCBA is utilized during possible venting procedures. As a result, air exchange rates and chemical dissipation have been used a mitigation approach for postapplication exposures (i.e., a dilution factor of 10,000 is used because of inherent chemical dissipation, relatively low volatility of pirimiphos methyl, and because forced air exchange should occur prior to entry into previously fogged areas). This results in the same exposure concentration of 0.00036 mg/L that was used to evaluate handler exposures. If this concentration is used to calculate a dose level using standard exposure parameters (i.e., 29 Lpm, 60 kg, and 2 hours per day), the resulting dose is 0.021 mg/kg/day which results in an MOE of 710. However, HED believes that this comparison is not biologically relevant because of the route-to-route extrapolation required (i.e., the MOE is based on a chronic oral endpoint and inhalation would be the primary exposure route in this scenario because of mechanical handling/planting and the use of gloves). See the risk characterization for this scenario described in Section 4.c for further information (**concerns over entry into previously fogged areas should be added to label -- proper ventilation/air exchange as stipulated in the U.S. EPA Worker Protection Standard, requirements for mechanical handling/planting, and requirements for glove use at planting**).

vi. Residential Post-Application Exposure/Risk Assessment

There are currently no pirimiphos methyl products that are marketed for application in residential marketplace. As such, no exposure/risk analysis was completed for these use scenarios.

c. Occupational and Residential Risk Assessment/Characterization

i. General Risk Characterization Considerations

Several issues must be considered that pertain to the quality of the assessment and when interpreting the results of the occupational handler and residential postapplication risk assessment. These include:

- No chemical-specific exposure or residue dissipation data were submitted. As a result, all analyses were completed using PHED data and assumptions related to the behavior of the chemical in the environment (e.g., postapplication inhalation exposures from fogging).
- Several handler assessments were completed using “low quality” PHED data due to the lack of a more acceptable dataset (see Exposure Scenario Table for further details).
- Several generic protection factors were used to calculate handler exposures. The protection factors used for clothing layers and gloves have not been completely evaluated by HED. The key element being evaluated by HED is the factor for clothing. The value used for respiratory protection is based on the *NIOSH Respirator Decision Logic* and the value for gloves is in the range that OSHA and NIOSH often use.
- Factors used to calculate daily exposures to handlers and for the post-application

scenarios (e.g., tons grain treated per day) are based on the best professional judgement due to a lack of pertinent data. Exposure descriptors have not been assigned to each scenario that has been assessed because the data to describe distributions for each exposure factor are not available. Available information pertaining to each factor is summarized herein to provide basic characterization information. The PHED surrogate exposure values can be described as values that are generally between the geometric mean and the median of the dataset used for calculation of the value.

Refinement of the ORE exposure and risk assessment calculations presented in this chapter is possible if the issues presented above are addressed by the registrant or if more refined approaches and data become available to HED.

ii. Summary of Total Risks to Occupational Handlers

Total risks for occupational handlers were assessed using the short-term and intermediate-term toxicological endpoints. Results from each assessment are presented below (i.e., Short-term assessment followed by Intermediate-Term assessment). A chronic risk assessment was not completed as HED believes that pirimiphos methyl use patterns do not lend themselves to chronic exposure scenarios.

HED identified exposure scenarios based on available labels and other use information such as the LUIS report. As indicated above in section 4.b, surrogate data were used to develop the exposure/risk assessment for occupational handlers (i.e., no chemical-specific data were available). In some cases, appropriate surrogate data were not available to serve as the basis for an assessment. The scenarios for which no appropriate data were available are presented below (for both short- and intermediate-term unless noted):

- (3) Application to livestock using impregnated ear tags; and
- (4b) Application to livestock using a ready-to-use solution on cattle using a trigger spray package.

Short-Term Occupational Handler Risks

In cases where appropriate surrogate data were available, a risk assessment was completed. The calculations of short-term total risks indicate that the MOEs are ≥ 1000 at the **baseline clothing** scenario (Table X):

- none.

The calculations of short-term total risks indicate that the MOEs are ≥ 1000 with the use of **additional clothing and PPE** for the following scenarios (Table XI):

- (1c) Loading liquids for fogging treatment of iris bulbs. Note: **No incidents have been reported at the nursery during these applications and the PPE scenario used, as indicated in descriptions provided by the professional applicators, may provide**

more protection than PHED scenario used for this assessment because they claim to use clean Tyvek coveralls, rubber gloves, and SCBA at each event);

- (2) Fogging treatment of iris bulbs (not based on empirical data but on theoretical calculations based on application rate, protection factors assigned to SCBA equipment, and only activities associated with actual fogging, not preparation of the equipment); and
- (4a) Application of a ready-to-use solution to cattle using a self-totalizing pour-on package (this assessment was based on the same open-pour mixer/loader data that served as the basis for scenario 1c assessment -- high confidence in unit exposure value/no use of protection factors/maximum application rate/treated unit value of tons/day based on best professional judgement, **this assessment should be considered as a rangefinder only because of the extrapolation that has been used to relate direct animal treatments to a typical mixer/loader scenario**);
- (5) Mixing/loading and applying liquids using a low pressure handwand for both top dress and bin disinfestation treatments (assessments at all mitigation levels were based on low to medium confidence unit exposure values, the use of protection factors in some instances, the maximum application rate, and a treated unit value of tons/day based on best professional judgement -- this assessment does also not reflect the additional exposure potential related to the top dress treatment);

The calculations of short-term total risks indicate that the MOEs are ≥ 1000 with the use of **engineering controls coupled with the baseline clothing/PPE scenario** for the following scenarios:

- (1a and 1b) Mixing/loading liquids for closed system admixture treatments to stored grain at all application rates or for closed system seed treatments (based on medium confidence unit exposure values that include the use of chemical resistant gloves, no use of protection factors, the maximum application rate, and treated unit value of tons/day based on best professional judgement -- **closed systems were indicated by the registrants at the January 1998 SMART meeting as the only application method, the labels need to be modified to reflect this requirement**).

Regardless of the level of risk mitigation applied to certain short-term exposure scenarios, MOE values **never exceeded a level of 1000**. These scenarios are presented below:

- (6) Mixing/loading and applying liquids using a backpack sprayer for both top dress and bin disinfestation treatments (assessments at all mitigation levels were based on low to medium confidence unit exposure values, the use of protection factors in some instances, the maximum application rate, and a treated unit value of tons/day based on best professional judgement -- this assessment does also not reflect the additional exposure potential related to the top dress treatment); and
- (7) Mixing/loading and applying liquids using a high pressure handwand sprayer for both top dress and bin disinfestation treatments (assessments at all mitigation levels were based

on low to medium confidence unit exposure values, the use of protection factors in some instances, the maximum application rate, and a treated unit value of tons/day based on best professional judgement -- this assessment does also not reflect the additional exposure potential related to the top dress treatment).

Intermediate-Term Occupational Handler Risks

Intermediate-term risks are included in this document, even though HED believes that the likelihood of an intermediate-term exposure pattern is somewhat unlikely given the intent of most pirimiphos methyl applications. There are notable exceptions including seed treatments and potential animal uses. In cases where appropriate surrogate data were available, a risk assessment was completed. The calculations of intermediate-term total risks indicate that the MOEs are \geq 300 at **baseline** for the following scenarios:

- none.

The calculations of intermediate-term total risks indicate that the MOEs are \geq 300 with the use of **additional clothing and PPE** for the following scenarios:

- (2) Fogging treatment of iris bulbs (See Section 4.b; not based on empirical data but on theoretical calculations based on application rate, protection factors assigned to SCBA equipment, and only activities associated with actual fogging, not preparation of the equipment).

The calculations of intermediate-term total risks indicate that the MOEs are \geq 300 with the use of **engineering controls coupled with the baseline clothing/PPE scenario** for the following scenarios:

- (1b) Mixing/loading liquids for closed system seed treatments (based on medium confidence unit exposure values that include the use of chemical resistant gloves, no use of protection factors, the maximum application rate, and treated unit value of tons/day based on best professional judgement -- **closed systems were indicated by the registrants at the January 1998 SMART meeting as the only application method, the labels need to be modified to reflect this requirement**).

Regardless of the level of risk mitigation applied to certain exposure scenarios, MOE values **never exceeded a level of 300**. These scenarios are presented below:

- (1a) Mixing/loading liquids for closed system admixture treatments to stored grain at the highest label application rate of 0.016 lb ai/ton (based on medium confidence unit exposure values that include the use of chemical resistant gloves, no use of protection factors, the maximum application rate, closed mixing/loading systems, and treated unit value of tons/day based on best professional judgement -- **closed systems were indicated by the registrants at the January 1998 SMART meeting as the only application method, the labels need to be modified to reflect this requirement**);

- (1c) Mixing/loading liquids for iris bulb fogging applications (assessments at all risk mitigation levels were based on high confidence unit exposure values, the use of protection factors in some instances, the maximum application rate, and an area treated unique to the nursery where these applications are completed -- **even though the MOE never exceeded 300 it should be noted that no incidents have been reported at the nursery during these applications and that the PPE scenario used, as indicated in descriptions provided by the professional applicators, may provide more protection than PHED scenario used for this assessment because they claim to use clean Tyvek coveralls, rubber gloves, and SCBA at each event**);
- (4a) Application of a ready-to-use solution to cattle using a self-totalizing pour-on package (this assessment was based on the same open-pour mixer/loader data that served as the basis for scenario 1c assessment described above, this assessment should be considered as a rangefinder only because of the extrapolation that has been used to relate direct animal treatments to a typical mixer/loader scenario);
- (5) Mixing/loading and applying liquids using a low pressure handwand for both top dress and bin disinfestation treatments (assessments at all mitigation levels were based on low to medium confidence unit exposure values, the use of protection factors in some instances, the maximum application rate, and a treated unit value of tons/day based on best professional judgement -- this assessment does also not reflect the additional exposure potential related to the top dress treatment);
- (6) Mixing/loading and applying liquids using a backpack sprayer for both top dress and bin disinfestation treatments (assessments at all mitigation levels were based on low to medium confidence unit exposure values, the use of protection factors in some instances, the maximum application rate, and a treated unit value of tons/day based on best professional judgement -- this assessment does also not reflect the additional exposure potential related to the top dress treatment); and
- (7) Mixing/loading and applying liquids using a high pressure handwand sprayer for both top dress and bin disinfestation treatments (assessments at all mitigation levels were based on low to medium confidence unit exposure values, the use of protection factors in some instances, the maximum application rate, and a treated unit value of tons/day based on best professional judgement -- this assessment does also not reflect the additional exposure potential related to the top dress treatment).

iv. Total Risks to Residential Handlers

Risks for residential handlers were not assessed as pirimiphos methyl products are not labeled for homeowner use.

v. Occupational Risks From Postapplication Exposures

HED believes that most postapplication exposures attributable to the use of pirimiphos methyl should be nominal based on the cultural practices associated with its use and based on the assumptions outlined in Section 4b (e.g., mechanical handling of treated grain and seeds).

The one exposure scenario that is of concern to HED, however, is entry into previously fogged iris bulb holding areas. HED believes that the level of risk associated with this scenario is acceptable provided that ample time is allowed for residue dissipation, the treated areas are properly aerated prior to entry, mechanical handling of treated iris bulbs or the use of chemical-resistant rubber gloves continues as was indicated in correspondence from the nursery where these operations are completed, and clothing/PPE (Tyvek, SCBA, gloves) similar to that used for the application process is used for excursions into treated areas for intervals prior to the normal postapplication bulb holding time of 3 to 4 weeks (e.g., for removal of fogging machine from treated area).

vi. Residential Risks From Postapplication Exposures

Postapplication residential risks were not assessed as pirimiphos methyl products are not labeled for homeowner use or for occupational use in a residential environment.

vii. Incident reports

Insert historical incident report section here from previous HED RED chapter.

viii. Data requirements

Short- and intermediate-term dermal and inhalation exposure assessments were made using PHED Version 1.1 data since no chemical-specific handler data were submitted. Chemical-specific handler studies may be required pending the outcome of recommended discussions with the registrants concerning appropriate risk mitigation options and **required label modifications**. Additionally, site-specific incident data should be provided for the iris bulb fogging use as well as information concerning the health and safety programs of the company that completes the fogging applications for the nursery (e.g., details of a respirator program that includes requirements for SCBA fit-testing and maintenance).

Similarly, label modifications must be made to reflect the assumptions used by HED to evaluate postapplication exposure potential (e.g., require mechanical handling of treated grain and seed, mechanical planting of iris bulbs, and requirements for proper ventilation procedures after iris bulb fogging applications).